

## **General Disclaimer**

### **One or more of the Following Statements may affect this Document**

- This document has been reproduced from the best copy furnished by the organizational source. It is being released in the interest of making available as much information as possible.
- This document may contain data, which exceeds the sheet parameters. It was furnished in this condition by the organizational source and is the best copy available.
- This document may contain tone-on-tone or color graphs, charts and/or pictures, which have been reproduced in black and white.
- This document is paginated as submitted by the original source.
- Portions of this document are not fully legible due to the historical nature of some of the material. However, it is the best reproduction available from the original submission.

"Made available under NASA sponsorship  
in the interest of rapid and wide dis-  
semination of Earth Resources Survey  
Program information and without liability  
for any use made thereof."

E7.3 105.10  
CR-131620

**MINERAL EXPLORATION AND FRACTURE TRENDS  
IN UTAH AND NEVADA, BY ERTS-1 IMAGERY**

**M. L. Jensen and M. Smith  
Department of Geological and Geophysical Sciences  
University of Utah  
Salt Lake City, Utah 84112**

**April 24, 1973  
Type II Report**

**Prepared for  
Goddard Flight Center  
Greenbelt, Maryland 20771**

(E73-10510) MINERAL EXPLORATION AND  
FRACTURE TRENDS IN UTAH AND NEVADA, BY  
ERTS-1 IMAGERY Progress Report (Utah  
Univ.) 7 p HC \$3.00  
CSCI 086

G3/13

Unclas  
00510

N73-22285

**TECHNICAL REPORT STANDARD TITLE PAGE**

1. Report No.		2. Government Accession No.		3. Recipient's Catalog No.	
4. Title and Subtitle  Fracture Trends Identified by ERTS-1 Imagery in Utah and Nevada				5. Report Date April 24, 1973	
				6. Performing Organization Code	
7. Author(s) M. L. Jensen and M. Smith				8. Performing Organization Report No.	
9. Performing Organization Name and Address  Department of Geol. and Geophys. Science University of Utah Salt Lake City, Utah 84112				10. Work Unit No.	
				11. Contract or Grant No. NAS5-21883 MMC 307	
12. Sponsoring Agency Name and Address  National Aeronautics and Space Administration Goddard Space Flight Center Greenbelt, Md. 20771				13. Type of Report and Period Covered	
				14. Sponsoring Agency Code	
15. Supplementary Notes  Author identified significant results.					
16. Abstract  Major structural trends have been compiled on five separate maps, at a scale of 1: 1,000,000, of Utah and Nevada from ERTS-1 imagery. An arbitrary length of ten kilometers has been chosen as a minimum length of the trends. The selection is based upon 1) obvious displacement of structures, 2) continuity or persistence of trends across structures, 3) line-up of outcrop patterns, drainage, erosional features or vegetation, and 4) near-linear trends. Several recognizable trend directions have been noted, viz., N 10-15° W, N 35° W, N 80° W, N 30° E, and E-W. More than 1500 structural trends have been identified, some of which are mineralized and extend into pediment or shallow alluvial cover. Those fracture trends that exhibit mineralization in exposed bedrock will be assayed for mercury content with a soil-gas analyzer and similar collection will be done over alluvial posture "blankets" by the same technique with the hope of discovering "blind" mineralized zones that are not exposed on the surface.					
17. Key Words (Selected by Author(s))  ERTS-1 Imagery Fracture Trends Lineaments and Faults				18. Distribution Statement	
19. Security Classif. (of this report)		20. Security Classif. (of this page)		21. No. of Pages	
				22. Price*	

\*For sale by the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

**Figure 2. Technical Report Standard Title Page**

MINERAL EXPLORATION AND FRACTURE TRENDS  
IN UTAH AND NEVADA, BY ERTS-1 IMAGERY

M. L. Jensen, GSFC ID No. 113, and M. Smith  
University of Utah, Salt Lake City, Utah 84112

Preface

The major endeavor of this ERTS-1 Contract is the application of the imagery to mineral exploration. This is being done by locating fracture trends on the imagery that are associated with mineralization. Those trends that extend into alluvial or post-ore cover are tested along the extrapolated trend with a soil-gas collector that measures the amount of mercury contained within the soilgas. Mercury at the surface appears to be an indicator of mineralization at depth.

Table of Contents

1. Introduction
2. Research Results
3. Mercury analyzer--New Technology
4. Field Study (Grand Truth) of Fracture Trends
5. Conclusions and Recommendations

## 1. INTRODUCTION

An ERTS-1 Image mosaic of the Utah-Nevada area was compiled and structural trends have been traced on a transparent overlay sheet (1:1,000,000 scale) with little regard for mapped geology. The trends are now being related to mapped geology to see what correlative events, especially with reference to mineralized zones, are evident.

## 2. RESEARCH RESULTS

Structural trends as they appear on the ERTS-1 Image have been traced on a transparent overlay sheet (1:1,000,000 scale) of the Utah-Nevada area. An arbitrary length of about one centimeter (ten kilometers on the ground) has been chosen as a minimum length of trends. Their selection has been based on:

1. Obvious displacement of structures.
2. Continuity or persistence of trend across structures.
3. Linear bearings (excluding man-made features).
4. Line-up of outcrop patterns, drainage, erosional features and vegetation.

Structures clearly traceable through bed rock are considered most reliable. Continuity, however, is frequently traceable through ranges and across adjoining sedimentary basins where changes in drainage, erosion pattern, soil color or vegetation suggest that the basin sediments are extremely sensitive to underlying structures. Many large and continuous trends, too smeared by erosion to be visible on the ground or from aircraft photos, become quite evident at the scale of the ERTS-1 images. One of these "lineations" is the "Towanta Lineament" across the Uinta Mountains (Howard Ritzma, personal communication, 1973).

Photos taken on different traverses vary considerably in contrast due to sun elevation and smog-haze distribution, and in the lineations which show up due to sun azimuth. The best structural trend analysis, therefore, depends on a comparison of repetitive photos of each area.

The study was made with little regard for surface geology. Nevertheless, there appears to be little correlation between the more persistent trends and present topography and rock type. Some trend directions appear to cross all geologic boundaries; others stop or change direction as they cross a boundary or strong cross-trend; still others change orientation gradually, forming an arcuate track across hundreds of miles as if a once-straight trend had been off-set by numerous younger faults. In the region west of the Wasatch line, the patterns become more contorted, suggesting strike-slip movement in several directions or possible rotational movement within the Great Basin.

The trends have been retraced to separate and uni-directional sets. These are now being related to surface geology, geophysical studies, volcanic and intrusive centers and areas of mineralization.

### 3. NEW TECHNOLOGY (soilgas mercury "sniffer")

One of the more promising exploration techniques that is now being developed for application to the ERTS-1 Contract is the collection of soilgas that almost invariably contains mercury. Simple techniques have been experimented with that enable the collection and analysis of the mercury contained in the soilgas.

An enclosed tripod or plastic hemisphere is placed on the ground at the specific collection site with the base buried several decimeters in the ground. A battery-powered fan draws the soilgas from the ground. It passes through a small orifice in the enclosed collecting instrument and through one or more layers of the silver screen. The mercury in the soilgas forms an amalgam with the silver. The amount of mercury collected is determined by an atomic absorption instrument where the mercury is vaporized by heating the silver screen in a small furnace.

With only a few minutes of operation of the fan, adequate samples of mercury are obtained for analyses. The basic factors that indicate the usefulness of this exploration

technique are as follows:

1. Mercury is associated as a trace element with the majority of mineral deposits.
2. The high vapor pressure of mercury allows it to continually "bleed" from a mineralized zone, even from considerable depths, where it can be trapped at the surface with the mercury soilgas collecting apparatus.
3. Mercury can be detected with atomic absorption instruments in concentrations of less than 0.1 ppb. The average abundance of mercury in many rocks is roughly 50-100 ppb and more in mineralized zones.

The use of this technique for tracing mineralized zones into pediment areas provides an exploration technique for prospecting for "blind" mineral deposits in limited zones indicated by the mineralized fracture trends detected in ERTS-1 imagery.

#### 4. FIELD STUDY OF FRACTURE TRENDS

Important structural trends which appear to be related to mineralized areas will be located as precisely as possible on the ground. Geochemical surveys will be made at right angles across one of these trends, testing for mercury (Hg) in soilgas, to check the possibility that the trend represents a deep fracture through the crust, providing a possible escapeway, now or in the geologic past for comparatively volatile elements. If the initial traverse shows positive, further traverses will be made across the extrapolated structural trends into post-ore alluvial covered areas to test the potential of covered mineralized zones. The first such trends to be studied will be the trend extending from the Uinta Mountains to Park City, Little Cottonwood Canyon and perhaps extending across Salt Lake Valley into the Oquirrh, Stansbury and Cedar Ranges.

Work will continue on the relation of ERTS-1 Imagery structural trends to geology mapped "on the ground", checking validity, continuity and reliability of the ERTS-1 trends.

## 5. CONCLUSIONS AND RECOMMENDATIONS

There appears to be a real correlation between the structural trends as seen on the ERTS-1 Imagery and many faults and mineralized fractures mapped on the ground or seen in mines. The latter appear to be fragments of larger, continuous structures which may be relatable to plate tectonic activity and conduits or mineralizing fluids. The study will continue with further selection of fracture trends, ground truth correlation and soilgas testing of mineralized trends that extend under the post-ore or volcanic cover.